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Upper Tier Core Course

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What is Forensic Science?

- It is the application of science to the law
- In criminal cases forensic scientists are involved in the search for and examination of physical traces which might be useful for establishing or excluding an association between someone suspected of committing a crime and the scene of the crime or victim.
Forensic Science

- In its broadest definition, forensic science is the application of science to criminal and civil laws.
- Forensic science owes its origins to individuals such as Bertillon, Galton, Lattes, Goddard, Osborn, and Locard, who developed the principles and techniques needed to identify or compare physical evidence.
Eureka!
The First Scientific Investigation

- **Archimedes** (287-212 BC) – Father of Forensic Science
- He discovered that a crown was not made of gold, (as it was falsely claimed) by its density and buoyancy
Next forensic science application was by Soleiman, an Arabic merchant of the 7th century. He used fingerprints as a proof of validity between debtors and lenders.
In the 700s, the Chinese also used the fingerprint concept.

In the 1000s, Quintilian, a prosecutor in the Roman courts, used a similar method to solve murders.
• The first document that mentions the use of Forensics in legal matters is the book *Xi Yuan Ji Lu* (translated as “Collected Cases of Injustice Rectified”) written in 1248 by Chinese author Song Ci.
Medics began to use their knowledge to investigate the cause of death.

Ambrose Paré, a French army surgeon, two Italian surgeons, Fortunato Fidelis and Paolo Zacchia were some of the pioneers in this field.
16th Century Written Records

- “A Treatise on Forensic Medicine and Public Health” by the French physician Fodéré
- “The Complete System of Police Medicine” by the German medic Johann Peter Franck and
- the first dissertation on systematic document examination published by François Demelle of France.
- In 1686, Marcello Malpighi, a professor of anatomy at the University of Bologna, identified the fingerprint method.
18th Century

- Groundbreaking work in Forensics. Swedish chemist Carl Wilhelm Scheele and German chemist Valentin Ross
- England also solved a number of murder cases using forensic science.
- In the year 1784 in Lancaster, John Toms was convicted of murder, when a torn bit of a newspaper in a gun was found matching a leftover paper in his pocket.
The following made history in forensic science

- Scholars like Thomas Bewick, an English naturalist
- Spanish professor of medicinal/forensic chemistry Mathiew Orfila
- John Evangelist Purkinji, professor of anatomy at the University of Breslau Eugène
- François Vidocq established the first detective force, the Sûreté of Paris.
Arthur Conan Doyle wrote the first Sherlock Holmes case in Beeton’s Christmas Annual of London.

Federal Bureau of Investigation in the United States.

At present, approximately 350 public crime laboratories operate at various levels of government—federal, state, county, and municipal.
Forensic Science - History

- Mathieu Orfila—the father of forensic toxicology.
- Alphonse Bertillion—devised the first scientific system of personal identification in 1879.
- Francis Galton—conducted the first definitive study of fingerprints and their classification.
- Leone Lattes—developed a procedure to determine blood type from dried bloodstains.
- Calvin Goddard—used a comparison microscope to determine if a particular gun fired a bullet.
- Albert Osborn—developed the fundamental principles of document examination.
• Walter McCrone—utilized microscopy and other analytical methodologies to examine evidence.
• Hans Gross—wrote the first treatise describing the application of scientific principles to the field of criminal investigation.
• Edmond Locard—incorporated Gross’ principles within a workable crime laboratory.
• Locard’s Exchange Principle—states that when a criminal comes in contact with an object or person, a cross-transfer of evidence occurs.
Sherlock Holmes
series between 1887 – 1893

Fictional character who provided the world with scientific ideas and techniques for solving crimes.
Sir Arthur Conan Doyle (1859-1930)

Physician & Fiction Writer

Adventures of Sherlock Holmes – Series (1887-1893)

1906 – Became the first forensic investigator
Sherlock Holmes

Bronze Bust in

Switzerland
Dr. John Watson & Sherlock Holmes

(Movie Characters)
Watson’s statement about Holmes’s knowledge of geology

“Practical but limited. Tells at a glance different soils from each other and is able to recognize splashes on his trousers from different parts of London.”
Hans Gross
(1847-1915)

Founder of
Scientific Criminal Investigation
George Popp

German Chemist & Forensic Scientist

1904 – First Investigator of Earth Materials
Edmond Locard

French Forensic Geologist

First to establish a police criminal lab in France

1910 - Established the “Exchange Principle” the fundamental tenet of Forensic Geology
Agatha Christie (1890-1976)

The Well known
Detective
Novel Writer
Mathieu Orfila – (1787 – 1853) Spanish "Father of Toxicology"

1807, he attended courses in medicine at the University of Valencia and chemistry at the University of Barcelona. He won a scholarship to the University of Madrid to study chemistry and mineralogy, but instead went to Paris. Buried - March 16, 1853, somewhere in France.
Alphonse Bertillon
(1853 – 1914)
Father of Criminal Investigation
Devised the first scientific system of Personal identification
RELEVÉ
DU
SIGNALEMENT ANTHROPOMÉTRIQUE

Sir Francis Galton F.R.S. 1822-1911
1892 – First to develop techniques of Finger Printing

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Prof. Leone Lattes

(1887 – 1954)

Blood grouping techniques
Calvin Goodard  
(1891 - 1955)  

Microscopic examination of  
Fire Arms  
Bullet Markings
Osborn S. Albert
(1858 – 1946)

Acceptance of documents as scientific evidence
Walter McCrone
(1916 – 2002)
Microscopist
The Crime Lab

• The development of crime laboratories in the United States has been characterized by rapid growth accompanied by a lack of national and regional planning and coordination.

• At present, approximately 350 public crime laboratories operate at various levels of government—federal, state, county, and municipal.
The ever increasing number of crime laboratories is partly due to

– Supreme Court decisions in the 1960s responsible for police placing greater emphasis on scientifically evaluated evidence.

– Crime laboratories inundated with drug specimens due to accelerated drug abuse.

– The advent of DNA profiling.
Crime Lab Technical Support

- Assigned to five basic services.
  - Physical Science Unit: incorporates the principles of chemistry, physics, and geology to identify and compare physical evidence.
  - Biology Unit: applies the knowledge of biological sciences in order to investigate blood samples, body fluids, hair, and fiber samples.
  - Firearms Unit: investigates discharged bullets, cartridge cases, shotgun shells, and ammunition.
Crime Lab Technical Support - Continued

- Document Unit:
  provides the skills needed for handwriting analysis and questioned-document issues.

- Photographic Unit:
  applies specialized photographic techniques for recording and examining physical evidence.

- Optional services:
  toxicology, fingerprint analysis, voiceprint analysis, evidence collection, and polygraph administration
Skills of a Forensic Scientist

- skilled in applying the principles and techniques of the physical and natural sciences to the analysis of the many types of evidence that may be recovered during a criminal investigation.
- may also provide expert court testimony.
- Serve as an expert witness: an individual whom the court determines possesses knowledge relevant to the trial (not expected of the average person).
Skills of a Forensic Scientist – Contd.

- The expert witness is called on to evaluate evidence based on specialized training and experience that the court lacks the expertise to do.
- The expert will then express an opinion as to the significance of the findings.
- Forensic scientists also participate in training law enforcement personnel in the proper recognition, collection, and preservation of physical evidence.
The *Frye* Standard

- The *Frye v. United States* decision set guidelines for determining the admissibility of scientific evidence into the courtroom.
- To meet the *Frye* standard, the evidence in question must be “generally accepted” by the scientific community.
Frye Not Absolute

• However, in the 1993 case of *Daubert v. Merrell Dow Pharmaceutical, Inc.*, the U.S. Supreme Court asserted that the *Frye* standard is not an absolute prerequisite to the admissibility of scientific evidence.

• Trial judges were said to be ultimately responsible as “gatekeepers” for the admissibility and validity of scientific evidence presented in their courts, as well as all expert testimony.
The *Daubert* Criteria

- In *Daubert*, the Supreme Court offered some guidelines as to how a judge can gauge scientific evidence:
  1) Whether the scientific technique or theory can be (and has been) tested.
  2) Whether the technique or theory has been subject to peer review and publication.
  3) The technique’s potential rate of error.
The *Daubert* Criteria – Contd.

4) Existence and maintenance of standards controlling the technique’s operation.

5) Whether the scientific theory or method has attracted widespread acceptance within a relevant scientific community.
Special Forensic Science Services

- A number of special forensic science services are available to the law enforcement community to augment the services of the crime laboratory.
- These services include forensic pathology, forensic anthropology, forensic entomology, forensic psychiatry, forensic odontology, computer science, and forensic engineering.
Special Forensic Science Services - contd

- Forensic Pathology involves the investigation of unnatural, unexplained, or violent deaths.
  - Forensic pathologists in their role as medical examiners or coroners are charged with determining cause of death.
  - The forensic pathologist may conduct an autopsy which is the medical dissection and examination of a body in order to determine the cause of death.
After a human body expires there are several stages of death.

- Rigor mortis
- Livor mortis
- Algor mortis
Special Forensic Science Services - Contd

- **Rigor mortis** results in the shortening of muscle tissue and the stiffening of body parts in the position at death (occurs within the first 24 hours and disappears within 36 hours).
- Livor mortis: results in the settling of blood in areas of the body closest to the ground (begins immediately on death and continues up to 12 hours).
Special Forensic Science Services - Contd

- **Algor mortis**: results in the loss of heat by a body (a general rule, beginning about an hour after death, the body loses heat by 1 to 1-1/2 degrees Fahrenheit per hour until the body reaches the environmental temperature).
Special Forensic Science Services - Contd

- **Forensic Anthropology** is concerned primarily with the identification and examination of human skeletal remains.

- **Forensic Entomology** is the study of insects and their relation to a criminal investigation, commonly used to estimate the time of death.

- **Forensic Psychiatry** is an area in which the relationship between human behavior and legal proceedings is examined.
Special Forensic Science Services - Contd

- **Forensic Odontology** involves using teeth to provide information about the identification of victims when a body is left in an unrecognizable state; also investigates bite marks.

- **Forensic Engineering** is concerned with failure analysis, accident reconstruction, and causes and origins of fires or explosions.

- **Forensic Computer Science** involves the examination of digital evidence.
Special Forensic Science Services - Contd

- **Forensic Geology**: deals with the geological aspects of crime